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## PETROLOGICAL ABSTRACTS AND REVIEWS

EDITED BY ALBERT JOHANSEN

CRAIG, WRIGHT, BAILEY, CLOUGH, AND FLETT. *The Geology of Colonsay and Oronsay, with part of the Ross of Mull.* Mem. Geol. Survey Scotland, No. 35. Edinburgh, 1911. Pp. viii + 109; plates VI; figs. 21; map 1.

Colonsay and Oronsay are two small islands of the Inner Hebrides, lying between Islay and Mull, and are formed chiefly of schistose, metamorphic rocks of sedimentary origin and probably of Lower Torridonian age. They include limestones, phyllites, mudstones, banded flags, sandstones, feldspathic and epidotic grits, and conglomerates, and have a thickness estimated to be at least 5,000 feet. The rocks are much folded and show two series of cleavages, the earlier of which is slaty cleavage and is separated from the later "strain-slip" by a period of igneous activity, during which time there were intruded several small masses of syenite and diorite and numerous lamprophyric dikes. Subsequently a series of vogesites were intruded. No sediments are found intermediate between the Lower Torridonian and those of the Glacial period, the long interval being represented only by the igneous intrusions.

The igneous rocks consist of quartz-hornblende syenite, kentallenite, and augite diorite. There are two phases of the syenite; a marginal phase which is very basic and full of included boulders, and an interior acid phase which is boulder free. The marginal phase is a dark rock consisting of short, stout crystals of hornblende and a little biotite in a scanty matrix of feldspar (perthitic orthoclase, with albite in some places) usually micrographically intergrown with quartz. A peculiar feature of this border facies is the fact that it is crowded with boulders of quartz and quartzite in all stages of assimilation, the unaltered portions being surrounded by halos of feldspathic material, usually potash feldspar and quartz with a little albite, formed by the combination of the dissolved silica with the basic magma. The "feldspathic ghosts" often retain the original shape of the boulders and indicate the tranquillity of the process of replacement and the viscosity of the magma, the later being indicated also by the uniform distribution of the lighter quartz boulders in the heavier magma. The authors say the rock can

best be described as hornblendite, passing into hornblende picrite in places, though differing from the normal types, which carry basic plagioclase, in that in these rocks the general feldspar is perthitic orthoclase with some albite. The rocks are intermediate between the syenites with which they are associated and the kentallenites. The influence which the included quartz boulders have had upon the magma is shown in the local concentration of the alkalis around them. In the magma, which is predominantly hornblendic, the quartz boulders are replaced by alkali feldspars and quartz. Calcium feldspars, such as one would expect in a calcic magma, are entirely absent.

The central acid phase of the intruded mass is quartz syenite, consisting of hornblende and less biotite in a matrix of feldspars, chiefly orthoclase with some albite, and quartz.

The kentallenite occurs in a mass about fifty acres in extent at Balnahard, and closely resembles the type rock from Kentallen Quarry. A porphyritic phase of this rock is also found.

Augite diorite, in the sense used by Hill and Kynaston, forms the largest outcrop of igneous rocks on the island. It is a black-and-white rock with about equal amounts of femag and feldspathic constituents. Under the microscope the rock shows a porphyritic texture with biotite, pale-green augite, some hornblende, and some pseudomorphs after olivine in a groundmass of about equal amounts of perthitic orthoclase and plagioclase—oligoclase and oligoclase-albite. (Query: porphyritic augite monzonite?)

The minor intrusions on both islands consist of dikes and sheets, and are lamprophyres, basalts, and a few felsites. The lamprophyres are all vogesites and generally strike in an east-and-west direction. The north-west dikes are olivine "dolerites" and monchiquites, the former being fine-grained dark rocks, rarely porphyritic or vesicular, of perfect ophitic texture, and consist of olivine, some biotite, zonal feldspars of labradorite with oligoclase rims in some places, and purple augite. The rock is a typical olivine diabase as the term is used in America. A variety of this rock but containing a considerable amount of analcite and zeolites occurs and of this the authors say it "may be described as analcite-bearing dolerite." To this rock the new name *Crinanite* is given. It is thus described:

The *crinanites*, then, are dark-coloured, fine-grained basic rocks consisting mainly of olivine, augite, and plagioclase felspar, with a considerable amount of analcite and zeolites. Olivine is abundant in small grains more or less altered to serpentine. The augite is always purple and is sometimes bluish

or plum-coloured; it is pleochroic . . . and the extinction angle about  $44^{\circ}$ . The pyroxene in fact belongs to the variety usually described as titaniferous and much resembles that which occurs in many basic nepheline-rocks and teschenites. Chemical analysis proves that the crinanites are rich in titanium. . . . The felspar has albite (rarely Carlsbad or pericline) twinning and belongs mostly to labradorite, though the outer zones are more rich in soda and may consist of oligoclase or albite. The iron oxides form irregular plates often fringed with small scales of dark brown biotite.

Most of these rocks have very perfect ophitic structure, and the augite occurs as small angular patches between the lath-shaped felspars or enclosing them. . . . In a few specimens there are large corroded felspar phenocrysts consisting mainly of bytownite. Analcite and radiating clusters of zeolites fill up spaces between the felspars or occupy small rounded steam cavities. Perfectly transparent analcite is not uncommon, but often this mineral is turbid and granular with weak double refraction. The radiate zeolite appears to be mostly natrolite. Evidently these have been the last minerals to crystallise, and as the rocks are often very fresh, it is difficult to believe that they have originated from the decomposition of the felspar. They are more properly a pneumatolytic infilling of interstitial spaces during a period immediately following the crystallisation of the pyrogenetic minerals. Carbonates and chlorite are often associated with them, and veins of analcite and zeolites, easily distinguished by their low refractive indices, often ramify through the substance of the felspar.

In their composition and in the properties of their minerals these crinanites bear much resemblance to the teschenites . . . but the teschenites are much coarser-grained, less frequently porphyritic and contain much more alkali felspar. The teschenites occur as large sills or laccolites, the crinanites as narrow vertical dykes which often can be followed for long distances in nearly straight lines. The crinanites in Colonsay show transitions to the camptonites, and are associated with monchiquites, some of which contain nepheline.

Monchiquite occurs in dikes and is composed of altered olivine, biotite, hornblende, and augite in a groundmass of analcite and carbonates. A nephelite ouachitite also occurs. The "felsite" dikes are described as "for the most part too decomposed for petrological examination."

The authors further describe the tectonics of the islands, their glaciation, and their economic resources.

In Part II the geology of the south part of the Ross of Mull is briefly described. The rocks here consist of metamorphosed sediments, intrusive granite and diorite, and dikes of vogesite, porphyrite, monchiquite, camptonite, "dolerite," and granophyre.

ALBERT JOHANNSEN

DAY, ARTHUR L., AND SOSMAN, ROBERT B. "The Melting-Points of Minerals in the Light of Recent Investigations on the Gas Thermometer, *Am. Journ. Sci.*, XXXI (1911), 341-49.

This article brings under one cover the previously published determinations of melting and other transition points made on the gas thermometer. One table contains the determinations that are considered accurate and another those that are only approximate. A bibliography of the original papers in which these results appeared is added.

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ALBERT D. BROKAW

IDDINGS, JOSEPH P. *Rock Minerals, Their Chemical and Physical Characters and Their Determination in Thin Sections*. Second edition, revised and enlarged. New York: John Wiley & Sons, 1911. 8vo, pp. xiii+617; figs. 500; and 1 colored plate.

The issue of a second edition of Professor Idding's book so soon after the first is an indication of its success. In this revised work but little change has made been in the first part; the insertion of a page and a half on pleochroic halos and the substitution of Michel-Lévy's recent, for his old diagram of extinction angles on combined Carlsbad and albite twins, being all. The second part is increased by 66 pages by the addition of about eighty minerals, chiefly those occurring in pegmatites and as segregated ores, representing extremes of magmatic differentiation.

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ALBERT JOHANNSEN

LEBEDEW, P. "Experimentelle Untersuchung einiger binärer Systeme von Silicaten," *Annales de l'Institut Polytechnique Pierre le Grand à St. Pétersbourg*, XV (1911), 690-720, figs. 2+11.

This article is in Russian with a two-page résumé in German. The studies are devoted to a diopside-olivine system and an anorthite-wollastonite system. In the first the eutectic point is reached with 40 mol. per cent olivine; in the second with 30 mol. per cent anorthite. Freezing-point curves of mixtures are plotted. In the résumé no question is raised as to whether either of these systems is a simple binary system. In the opinion of the reviewer the second at least should be considered a ternary system—either a part of the  $\text{CaO-Al}_2\text{O}_3\text{-SiO}_2$  system studied by Shepherd and Rankin, or of a  $\text{CaSiO}_3\text{-CaAl}_2\text{Si}_2\text{O}_6\text{-Al}_2\text{SiO}_5$  system, neither of which is so simple as the diagrams and the German résumé seem to indicate.

ALBERT D. BROKAW

LOEWINSON-LESSING, F. "Ueber die chemische Natur der Feldspath amphibolite, *Annales de l'Institut Polytechnique Pierre le Grand à St. Pétersbourg*, XV (1911), 559-76. 32 analyses.

The article is in Russian with a three-page résumé in German. The author shows that the feldspar amphibolites do not all fall into the chemical type of gabbro or diabase. In his 32 analyses he recognizes the following types: Melaphyre, Essexite, Gabbro-Norite, Vogesite Tephrite basalt, Shonkinite, Diabase, Gabbro-syenite Basanitic magma, Camptonite, two transition types, and certain special types not represented by any known eruptive rock.

According to texture the feldspar amphibolites are divided into four groups as follows: glomeroblastic, microgranitic, hornfels structure, and anomalous porphyritic texture.

Emphasis is placed on the lack of identity of chemical type in the feldspar amphibolite group.

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ALBERT D. BROKAW

LOEWINSON-LESSING, F. "Ueber eine bisher unbeachtet kristallochemische Beziehung," *Centralblatt für Mineralogie, Geologie, und Paläontologie*, Jahrg. 1911, pp. 440-42.

The writer recalls the fact that double salts and hydrates usually crystallize with lower symmetry than the respective simple salts and anhydrous bodies and proceeds to point out that such minerals as may be considered compounds of a silicate and a non-silicate have higher symmetry than the constituent silicate. As examples he cites: Nephelite is hexagonal, while noselite, sodalite, and hauynite are isometric. Albite is triclinic while marialite (albite+NaCl) is tetragonal. Similarly helvite, danalite, melinophane, leucophane, the melanocerite group, and certain other complexes of this sort all develop higher symmetry than their silicate constituent alone. Apparently the symmetry of the non-silicate constituent is neglected.

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ALBERT D. BROKAW

SCHNEIDER, KARL. *Die vulkanischen Erscheinungen der Erde*. Berlin: Gebrüder Borntraeger, 1911. Pp. viii+272, figs. and maps 50. M. 12, unbound.

The author has compiled, from many scattered and sometimes not readily accessible sources, data on vulcanism; much of the information being here brought together for the first time. The presentation is chiefly descriptive, genetic explanations rarely being given.

Vulcanism is defined as that phenomenon by which juvenile materials are brought from the interior of the earth into or upon its crust. These materials are divided into three groups: "rheumatitische" (ῥεῦμα, to flow), or that material which was poured out in a molten condition, "klasmatitische" (κλασμα, broken, fractured), material that is angular, broken, or rounded, and "pneumatolitische," or gaseous material. Since observations of eruptions cannot always be used in determining the history of a volcano, a morphological, topographical, geologic, petrographic, chemical, and physical study of previous eruptions must be made of former lava flows. The author gives his objections to the application of local for specific names for certain phenomena, as is done in the nomenclatures of Seebach and Stübel.

The most striking feature of a volcano is its built-up cone, and it is upon a study of the various characteristic forms which may be easily correlated with ideal sections, and upon a study of the materials which built up these cones, and of the forces which produced them, that the safest and most positive classification can be built. Too little regard, says the author, has heretofore been paid to "klasmatitische" material and he proposes a classification based upon the forms of the hill produced by the erupted material. Yet the author's own statement that the klasmatitic material may become the sport of the wind or be carried off by rainfalls shows how the outlines of a volcano may be altered to a remarkable degree in different latitudes. This would invalidate the classification to some extent, for it is, after all, based upon the topographic forms produced by the materials not carried away. Neither does the classification take into consideration the gaseous emanations upon which the character of an eruption somewhat depends.

Seven different types of volcanoes are recognized according to size, structure, and form.

"Pedionites" are characterized by the great extent of their lava flows. No volcano of this type is known for certainty in historic times. The material is generally rheumatic though some klasmatitic is found. The Deccan is an example of a pedionite.

"Aspites" are characterized by bases which are wide in proportion to their height. They usually have a crater on the summit and the material is generally rheumatic. Mauna Loa is an example. Vesuvius is a pseudoaspite.

"Tholoides" have slopes of over  $35^{\circ}$  and are convex upward. Like the preceding, the material erupted is rheumatic but the height of the cone is greater in proportion to its base. This form is characteristic of

the older volcanoes, and Puy de Dome and Puy de Sarcouy are typical. In modern times it is rare, the cone Georgious on Santorin being the only one known to form in historic times.

"Belonites" have much greater height than base. They are easily destroyed, consequently few remain, Pelée being the only one recently formed.

"Konides" are related to Tholoides in having an intermediate base relative to height. The flanks are always concave upward and the material is chiefly klasmatitic, though much is rheumatitic. In many cases there is a crater on the peak. It is the type of most recent volcanoes and Fujiyama is a good example.

"Homates" are characterized by an increase in base and a decrease in height but on the whole they are small in their dimensions. They all surround a crater with the slopes inside and outside about equal and concave upward. The material is usually klasmatitic. Many recent volcanoes are of this type and many such cones occur on, or in, the craters of konides. Monte Nuovo, Hverfjell in Iceland, and some of the piperno volcanoes of the Campi phlegraei belong here.

"Maare." These have usually been called diatremes. In typical form they are of elliptical cross-section and penetrate the older formations without having built up cones at the surface. These volcanic tubes are not rare since Tertiary times and are of several types, depending upon the force of the eruption. When the tubes extend straight through the surrounding strata the author classifies them as of the "Alb" type when the older strata are bent downward, at the sides, they form the "Fife" type, when they are bent upward at the sides, the "Cape" type. In the "Rez" type the strata are bent upward around the tube but the material does not reach entirely to the surface. These are Lachmann's hemidiatremes.

In tabular arrange ment these forms may be grouped as follows:

Older	{ Rheumatitic forms	Older forms	{ Pedionite
			{ Aspite
Intermediate	{ Rheuklastitic forms	Younger forms	{ Tholoide
			{ Belonite
		.....	Konide (Pseudoaspite)
Younger	{ Klasmatitic forms	.....	{ Homate
			{ Maare



The cycle of activity appears somewhat as follows. In the full strength of a volcano's activity the material ejected is rheumatitic and a pedionite is formed. The activity gradually becomes less, and asrites, finally tholoides and belonites appear. Sometimes succeeding the asrite stage there is an alternation of rheumatitic and klasmatitic material, and konides are formed, the klasmatitic material forming homate cones during the process. Sometimes the intermediate konide stage does not appear and asrites are followed directly by homates or contain them in the later stages. When the activity decreases still further the pneumatolitic stage is reached and the cycle is closed.

The formation of pedionites, asrites, or konides extends through a long period of time, while homates and maares have a brief period of development. The explosive process can represent only a single act after whose conclusion the activity must be closed forever. Nowhere do other forms succeed tholoides or belonites, but pedionites and asrites are succeeded by younger forms. Konides always show, in their entire cone, the story of the altering forces. They often carry on their extinguished summits the youthful, rapidly built homates, the work of a short explosive outbreak. Since the sequence is never reversed, the subsequent history of a volcano can be predicted, and the close of a cycle is indicated by the form of its last outburst. A volcano cannot be considered as active simply because, like Monte Nuovo and El Nuovo, it has had an eruption within historic times. From the forms of these cones it is seen that they will never again be active. Other volcanoes, such as Tambora, Tarawera, and Krafla, which began their activity in Tertiary times, are to be considered extinct also, for their last eruptions were of klasmatitic material only. This fact is of significance when it is applied to such volcanoes as Adatura or Dekeyama in Japan which, while it has had no outbreak in 2,100 years, has during all that time given off considerable pneumatolitic exhalations. The last outbreaks, however, were klasmatitic, and the types are those of the closing cycle.

The forms, then, of the cones produced, give the key for the determination of the stage of a volcano's history. To say that a volcano, which has erupted within the knowledge of man, may again become active, or that one which has never within historic times broken forth is extinct, is to base the assertion upon insecure data.

Succeeding the discussion of the classification of volcanoes, the author gives a chapter on the volcanic formations of central Europe since the Tertiary, and considers the geographic distribution of the active volcanoes of the present time. The chief volcanoes and volcanic zones are described

and sketch maps of their locations are given in very complete form, running through fifty pages of the book. The volume is concluded with a catalogue of volcanoes which have been active within historic times. Three hundred and sixty-seven are recorded with their names, latitude and longitude, absolute and relative height, and dates of eruption. As the author says in his introduction, the observations upon which the determination of activity is based are of very unequal value. For example, it may be noted that in the United States Mt. Hood is recorded as having been active in 1854, 1859, 1865, and 1866; Mt. Baker in 1843, 1853, and 1859; Mt. Ranier in 1841, 1843, and 1894; and Mt. St. Helens in 1837(?), 1841, 1842, 1854, and 1889. The author does not give his authority for the dates of eruptions and there may be many other volcanoes listed whose activity is as doubtful as the American. Eruptions of Mt. Ranier and Mt. St. Helens within historic times are extremely doubtful. Mt. Baker may have been active in 1843, and smoke by day and a glow one night were reported to have been seen on Mt. Hood in 1907 from a distance of a number of miles. In no case, however, is there record enough to more than place the volcanoes of the United States in the doubtful list. While many references to the literature of different outbursts are to be found in the earlier chapters, it is to be regretted that a complete bibliography of the various eruptions is not given so that one might determine the relative value of the observations.

The presswork of the book is clean and good but its appearance is greatly marred by muddy half-tones and crude line drawings. Throughout the work the bibliographic references in general, are good and complete, and are given in footnotes.

ALBERT JOHANNSEN

SMOLENSKY, S. "Schmelzversuche mit Bisilicaten und Titanalen," *Annales de l'Institut Polytechnique Pierre le Grand à St. Pétersbourg*, XV (1911), 245-63; figs. 5+10.

These studies are devoted to melts of a  $\text{CaSiO}_3$ - $\text{CaTiO}_3$  system and a  $\text{MnSiO}_3$ - $\text{MnTiO}_3$  system. The first falls into Type III according to Roozeboom, having a minimum melting-point with 33.4 mol. per cent of  $\text{CaTiO}_3$ . The second falls into Type V, giving a discontinuous series of mix crystals having a eutectic point with 38.3 mol. per cent  $\text{MnTiO}_3$ . Curves of the two systems are plotted from experimental results. Attempts to study a similar system with barium salts were complicated by lack of knowledge of the polymorphism of  $\text{BaSiO}_3$ . The article is in Russian with a two-page résumé in German.

ALBERT D. BROKAW

WOŁOSKOW, A. "Schmelzversuche über Bisilicate mit Sulfiden und Halogenverbindungen," *Annales de l'Institut Polytechnique Pierre le Grand à St. Pétersbourg*, XV (1911), 421-42, figs. 6; 4 photomicrographs.

The article is in Russian with a two-page résumé in German. Solidification curves were studied by means of a Kurnakow self-registering pyrometer. The results are as follows:  $\text{MnSiO}_3 + \text{MnS}$ , eutectic with 6.85 mol. per cent MnS,  $1130^\circ \text{C}$ .  $\text{BaSiO}_3 + \text{FeS}$  gave rise to a liquation of FeS and  $\text{BaSiO}_3$  containing 10 mol. per cent FeS.  $\text{BaSiO}_3 + \text{BaS}$ , eutectic with 25 mol. per cent BaS,  $1325^\circ \text{C}$ .  $\text{BaSiO}_3 + \text{BaCl}_2$ , eutectic with 8 mol. per cent  $\text{BaSiO}_3$ ,  $902^\circ \text{C}$ . Solidification curves of various mixtures are given.

ALBERT D. BROKAW

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WÜLFING, E. A. *Ueber die Lichtbrechung des Kanadabalsams*. Sitz. Heidelberger Akad. Wiss., Math.-naturw. Kl., 1911, 20 Abhandl., pp. 1-26.

Calkins (*Science*, XXX [1909], 973), compared the indices of refraction of Canada balsam with various minerals in 300 thin sections from one to eight years old, and found that in only one case out of a hundred did the index of balsam exceed 1.544. The lowest value obtained was between  $1.535 \pm 0.002$ . He gives 1.54 as a fair mean, and says it rarely has an index of less than 1.535 or greater than 1.545. Schaller (*Am. Jour. Sci.*, XXIX [1910], 324), with an Abbé-Zeiss reflectometer, found that uncooked balsam in sodium light had an index of 1.524, soft-cooked an average of 1.5387, as usually cooked an average of 1.5377, and over-cooked an average of 1.5412 with a maximum value of 1.543. Wülfing in the fourth edition of Rosenbusch-Wülfing's *Physiographie*, Vol. I, Part I, p. 150, gave the value of the index of balsam as  $\approx 1.54$ , and in the same volume, Part II, p. 345, said it varied between 1.542 nearly to 1.550.

In the present paper Wülfing gives determinations made by comparison with minerals in thin sections prepared 30 to 40 years ago, and also determinations made with an Abbé-Pulfrich total reflectometer which had been tested, for weeks previously, for errors. On a collection of thin sections prepared by Voigt and Hochgesang 30 years ago the value  $n = 1.538 \pm 0.002$  in the central portions of the slides and at the borders, which had become yellow with age,  $n = 1.5416$ . On other sections values

between 1.5330 and 1.5382 were obtained, the mean value being  $n = 1.537 \pm 0.004$ . In order to determine if there was any difference in the indices of the original balsam used, tests were made upon samples submitted by six different firms. Incidentally, in making these determinations, the values of the indices of refraction of certain minerals were obtained. It was found that chalcedony, when occurring in rather coarse fibers, is practically uniaxial and has indices  $\alpha = \beta$  or  $\omega = 1.530$ ,  $\gamma$  or  $\epsilon = 1.538$ . Hydrargillite has values for  $\alpha$  and  $\beta$  considerably higher than usually given, at least equal to 1.57. In most cordierite,  $\alpha = 1.534 \pm 0.003$ ,  $\beta = 1.539 \pm 0.003$ ,  $\gamma = 1.541 \pm 0.003$ . Nephelite, so far as the indices are concerned, is of two kinds; nephelite from Vesuvius (nephelite I) has  $\omega = 1.5418$  and  $\epsilon = 1.5378$ , while elaeolite from Hot Springs, Ark., has  $\omega = 1.5466$  and  $\epsilon = 1.5417$ .

In regard to Canada balsam, the author concludes that the indices of the majority of the slides of the Heidelberg collection lie between 1.533 and 1.541, and in only rare cases do they reach 1.544 or fall below 1.533, both cases being due to fault of manufacture. Balsam which has turned yellow does not always have a high index, but all balsam when exposed to the air discolours, becomes brittle, and increases in index. The balsam protected by the cover-glass or by a crust of balsam may retain its sticky consistency and low index even after 40 years; it is therefore, altered only on the surface or at the border of the cover-glass. Commercial balsams are so uniform that in the preparation of thin sections the limiting values of the index need not fall beyond 1.533 and 1.541, and, with practice, should be between 1.534 and 1.540.

ALBERT JOHANNSEN